What is claimed is:

1) **A coal-based cellular product comprising a matrix of cells having integral stiffeners or load paths, directed heat transfer paths and/or directed mass transfer paths defined in said matrix by cells of a different density or of a different size.**

2) **The coal-based cellular product of claim 1 prepared from bituminous coal.**

3) **The coal-based cellular product of claim 2 wherein said bituminous coal has a swell index of between about 3 and about 5.**

4) **The coal-based cellular product of claim 2 wherein said bituminous coal has a Gieseler plasticity value above about 500DDPM.**

5) **The coal-based cellular product of claim 1 wherein said stiffeners or load paths, directed heat transfer paths and/or directed mass transfer paths are due to the presence of coal-based cells of a structure differing from those comprising the matrix.**

6) **The coal-based cellular product of claim 1 wherein said stiffeners or load paths, directed heat transfer paths and/or directed mass transfer**

paths are due to the presence of coal-based cells of different densities than those comprising the matrix.

7) The coal-based product of claim 3 wherein said stiffeners or load paths, and mass transfer paths are defined by the presence of coal-based structure of higher density or greater cell wall thickness than that of the surrounding matrix.

8) A method for the production of a coal-based cellular product comprising a matrix of cells having integral stiffeners or load paths, directed heat transfer paths and/or directed mass transfer paths defined in or about said matrix by cells of a different density or of a different size said method comprising:

A) selecting as the matrix material a first coal-based precursor ground to a particle size below about 1mm which matrix material will, upon expansion, provide a matrix of an appropriate strength and density;

B) selecting a second coal-based precursor ground to a particle size below about 1mm, but of a different particle size than that of said matrix, said second coal-based precursor when expanded providing the required integral stiffener or load paths, heat transfer paths and/or mass transfer paths;

C) loading each of said selected coal-based precursors into each of at least two predefined volumes of a mold separated by appropriate partition(s) to define said matrix of said first coal-based precursor having said integral stiffeners or load paths, directed heat transfer paths and/or mass transfer paths defined by said second coal-based precursor in or about said matrix;

D) heating said mold under a non-oxidizing atmosphere to a temperature of between about 300°C and about 700°C and soaking at this temperature for a period of from about 10 minutes to about 12 hours; and

E) controllably cooling said coal-based product.

9) The method of claim 8 wherein said partitions are removed prior to initiation of said heating.

10) The method of claim 8 wherein said partitions remain in place during said heating and are either integrated into the coal-based product or vaporized.

11) The method of claim 8 wherein said mold comprises glass or ceramic.

12) A method for the production of a coal-based cellular product comprising a matrix of cells having integral stiffeners or load paths,

directed heat transfer paths and/or directed mass transfer paths defined by or about said matrix by cells of a different density comprising:

A) placing a coal-based precursor ground to a particle size below about 1mm into a thermally conductive mold;

B) placing said mold into a pressure chamber under a non-oxidizing atmosphere;

C) heating said mold at a rapid heat-up rate to a temperature of between about 300°C and about 700°C and soaking at this temperature for a period of from about 10 minutes to about 12 hours; and

D) controllably cooling said coal-based product

to provide a product comprising a relatively less dense coal-based cellular core surrounded by a relatively more dense and therefore less permeable skin.

13) The method of claim 12 wherein said mold comprises aluminum or steel.